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## HISTORY IN TOOLS

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IN modern teaching, political history has overshadowed all other aspects of man, and the general history of civilisation has not yet received recognition. It matters nothing whether Aristotle, Euclid, Newton or Pasteur, lived under a republic or a despotism ; but it is of the first importance in history to know the influence of such thinkers and discoverers. The movement of man's mind in ideas, knowledge, and abilities should be one of the principal and most stimulating subjects in education. This would not be a materialistic limitation, and one side of it has been admirably written already in Lecky's *History of Morals*.

Among the activities of man, the development of his means of work must certainly be considered. But while there are many books on offence and defence, arms and armour, there is none that traces the history of the mechanical aids. Thousands of writers have described the sculptures of the Parthenon, not one has described the means used in performing that work. It is a mystery to us how fluted columns with an entasis could be produced, true to a hundredth of an inch, in the diameters between the deep groovings.

In taking up the neglected history of tools,<sup>1</sup> the nature of the materials used is the first view to consider. After the stone ages, the order of metals,—bronze and then iron,—is tolerably well known. Of late years an earlier age of copper has been noticed in several countries ; and this again may be divided into an age of native copper and an age of smelted copper. The use of copper in the American hemisphere was entirely limited to native copper, never smelted ; in fact it was the stone age, including a malleable stone. Native copper is also found in various places in Europe and Asia, and it seems only

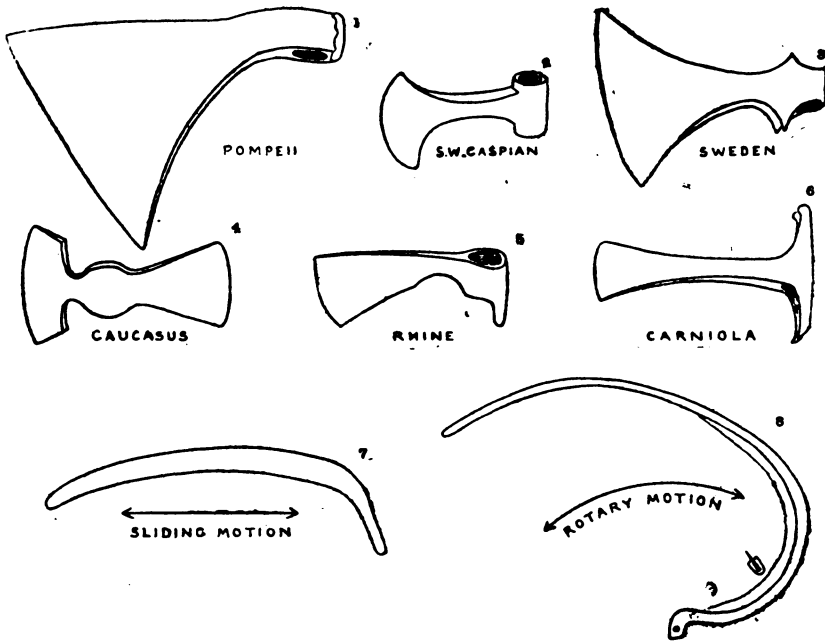
<sup>1</sup> A first step in historical treatment I have attempted, in a catalogue comparing the tools of Egypt with those of other lands, '*Tools and Weapons*, with 3,000 figures.

reasonable to suppose that it would be worked before smelting was discovered. What points to this is the pillowy form of tools in the earliest metal age of most countries. This form could not be cast except in closed moulds, but it would be the most natural for hammered native metal. The earliest stage of casting was the mere limiting of out-poured metal in an open mould, and hence flat castings, such as are found in Egypt, and such as appear in other countries after the hammered forms. The order of use of metallic materials, then, seems to be native copper, smelted copper, bronze, iron, steel, and brass. Copper may be hardened by small impurities and much hammering, until it is equal to any bronze ; the main purpose in using bronze was probably to facilitate casting, especially for closed moulds. The *cire perdue* process also needed bronze, and that was a favourite mode of work, from early Egypt to early Britain. In both those lands the metal was run to an astonishing thinness, often only a fiftieth of an inch, a mere film over the sand-core.

When the variations of the forms of tools in different countries are compared, much is seen to depend upon climate. In the north (figs. 3, 4) sockets are much larger and deeper than in the south (figs. 1, 2) ; this is due to the softer and more stringy nature of northern woods, which would be bruised and crushed in the leverage of a small socket. Neither oak nor ash nor beech could compare with the Syrian *shum* for resisting a wrench. The varying purposes also led to very different forms ; the slight socket and large blade for a fighting axe, when the blade was not gripped in the cleavage ; the splitting axe with a long socket to enable a side-wrench to be given ; the cleaving axe with a long back to the socket (figs. 5, 6) to aid in a lifting pull to get it out of the wood. In the agricultural tools there are clear distinctions between the scythe or sickle worked with a sawing motion from the hand at the end of the blade (fig. 7), or the reaping sickle with a circular arc around the wrist which rotates it (fig. 8), or the pruning-hook to top off high vine-sprays in the south (fig. 46), or the bill-hook to cut copse-wood in the north. The different kind of motion must be considered before we can understand the varying use of each tool. In weapons, similarly, the width of spear or arrow-head is conditioned by the defence. On bare bodies wide cutting blades are the most effective, to attack clothed bodies a narrower

blade is needed, and for piercing armour of leather or metal a mere spike is required.

These forms which result from the necessities of use, and the guidance of utility, may very probably be evolved in many different centres quite independently. We know, in modern times, the Patent Office shows how often a simple thing may be reinvented. The case is different, however, when we look at artistic style ; in that, each race or country has its own characteristics which cling to it for ages, and are seldom adopted by



FORMS OF SOCKET : 1, 2, small for hard wood ; 3, 4, lengthened for softer wood ; 5, 6, for lifting.

FORMS OF REAPER : 7, sliding cut, Swiss ; 8, rotated round wrist, Egypt.

others. When a design recurs we can generally trace its descent, sometimes through thousands of years. Sometimes principles of form also have an astonishing persistence. The northern and Syrian peoples used flanged edges to stiffen tools, the Egyptian and most Mediterranean peoples would have none of them. The European and Asiatic used socket-holes, the Egyptian always rejected them. The European cast in flat moulds, and used punched ornament ; the Asiatic cast in closed moulds, and used cast relief ornament. The Asiatic and

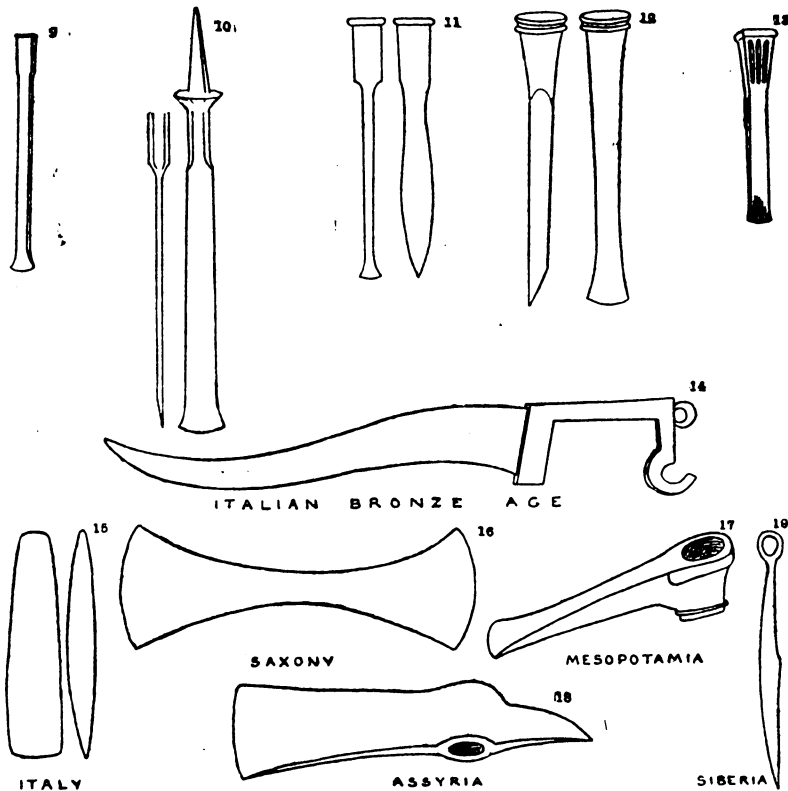
East European used re-curved outlines, the European and Egyptian used straight or simply curved outlines. In all these respects we see a fundamental artistic difference between races.

Another curious aspect of the subject is the worship or reverence given to weapons. Spears were kept in the temples of Italy as means of divination, and immense ceremonial spear-heads are known from early Mesopotamia, Italy, Sweden, Britain and China. The scimeter was adored in Scythia, and the Quadi adored their swords as deities. The driving of a nail into the temple of Jupiter in Rome was the means of averting pestilence. The double axe was a usual tool, and also a sacred form ; ceremonial copies, which could not be hafted (fig. 16) were made in various northern centres, apparently as standard weights.

Several stages of inventive activity may be discovered, when a great outburst of new types appears. The most prolific period seems to have been in the later bronze ages, about 900 B.C. The most perfect forms of bronze chisels were then devised (figs. 9 to 13), both tang and socket chisels, wide chisels, deep mortise chisels, saws with a uniform rake to the teeth to cut in one direction, great knives of a flamboyant form (fig. 14) with double curves,—all due to north Italian genius. About the same time, or a little later, the Chalybes on the Assyrian side were developing iron and steel tools on modern lines, socket and tang chisels, saws, rasps, and the early stages of files and centre-bits. These were in use about 700 B.C. It is also noticeable how a great wave of ethical ideas appears in that age in Judæa, Greece and Egypt ; it seems to have been a potent stage of thought in many branches.

Some tools which have been, and still are, very usual in other lands, are little known in the West. The adze had a very long career, from the early prehistoric age of Egypt, and is still the common tool of the East. It is often now confused with the axe, under the general name of celt ; but it is essentially different, being unsymmetrical in side view, and used across the plane of motion. One common form of it, from about 1500 to 400 B.C., has scarcely been noticed hitherto ; it has two projections on the side-edge to hold up the lashing which attached it to the handle. It is strange to see how a tool which was commonly used in many countries for a thousand years, has now disappeared from life as totally as the mammoth.

It is too often supposed that because some thousands of years have passed in the history of a tool, therefore we must now be in possession of far better forms than those of past ages. This is true in many cases, but by no means always. The forms of the chisel were perfected 2,500 years ago ; and the beauty of work in the bronze age chisels (fig. 10) with perfectly even



9 to 14.—Bronze Age inventions of Italy ; not used by Egyptians.

15 to 19.—Forms not used by Egyptians.

blades, dished octagonal flanges to the tang, or square sockets ribbed on the outside for strength (fig. 13), has never been exceeded. In other tools there has been an actual loss of good design. The Egyptian form of the Roman shears has one leg detachable for sharpening (fig. 36) ; it was held in place by two slots engaging T-shaped pins, it could be detached in a second, and yet was quite firm. Such a facility for sharpening

is a great advantage, but the form has entirely disappeared. Another Egyptian form was the iron sickle (fig. 8), with a trough groove to hold a strip of steel teeth ; this was adapted from the old Egyptian wooden sickle with flint saws inserted, and when steel was valuable it was a great advantage, yet it entirely died out from use. The use of saws and crown drills with fixed teeth of corundum or gem stones, for cutting quartz rocks, was the regular system of work in Egypt 6,000 years ago, and in Greece 4,000 years ago. The cores produced were so perfect and clean-cut that, as Sir Benjamin Baker said, any engineer would be proud to turn out such good work with the best diamond drills. The saws were over eight feet long, sawing blocks of granite  $7\frac{1}{2}$  feet long.

This splendid work was quite forgotten, the Roman had no such grand tools, and some thousands of years passed before such means were reinvented fifty years ago.

In other cases we can trace the gradual evolution of a tool down to the present day. The carpenter's saw was at first merely a blade roughly hacked on the edge ; by 4,500 B.C. it had regular teeth, sloping equally both ways ; by 900 B.C. the Italian gave a rake to the teeth to make them really cut in one direction, instead of merely scraping as before. No ancient saw, however, had a kerf, cutting a wider slit than the thickness of the blade ; we do not know when that was invented in the Middle Ages. The Egyptian used a push-saw as the earliest form ; the pull-saw was the only one in the West and the Roman world ; the push-saw came back into use in the last few centuries, though the pull-saw in a frame is still universal in the East. The world did without shears for many ages, cloth being cut with a rounded-blade knife (fig. 34). About 400 B.C. the mechanical genius of Italy invented the shears, which in two or three centuries more were fitted to the fingers, and thus started the scissors. The snuffers in Exodus is a mistranslation ; the early tools for trimming a lamp were a small knife and pair of tweezers to trim the wick, and a point to part the strands.

In some cases it is curious to see how long men remained on the brink of an invention. Copper wire was made by cutting and hammering, from 5,500 B.C., yet the drawing of wire remained unknown for 6,000 years or more. When the first drawn wire was made is not yet fixed, but it seems to have been unknown to the Romans. Thick beaten wire was made into chain with

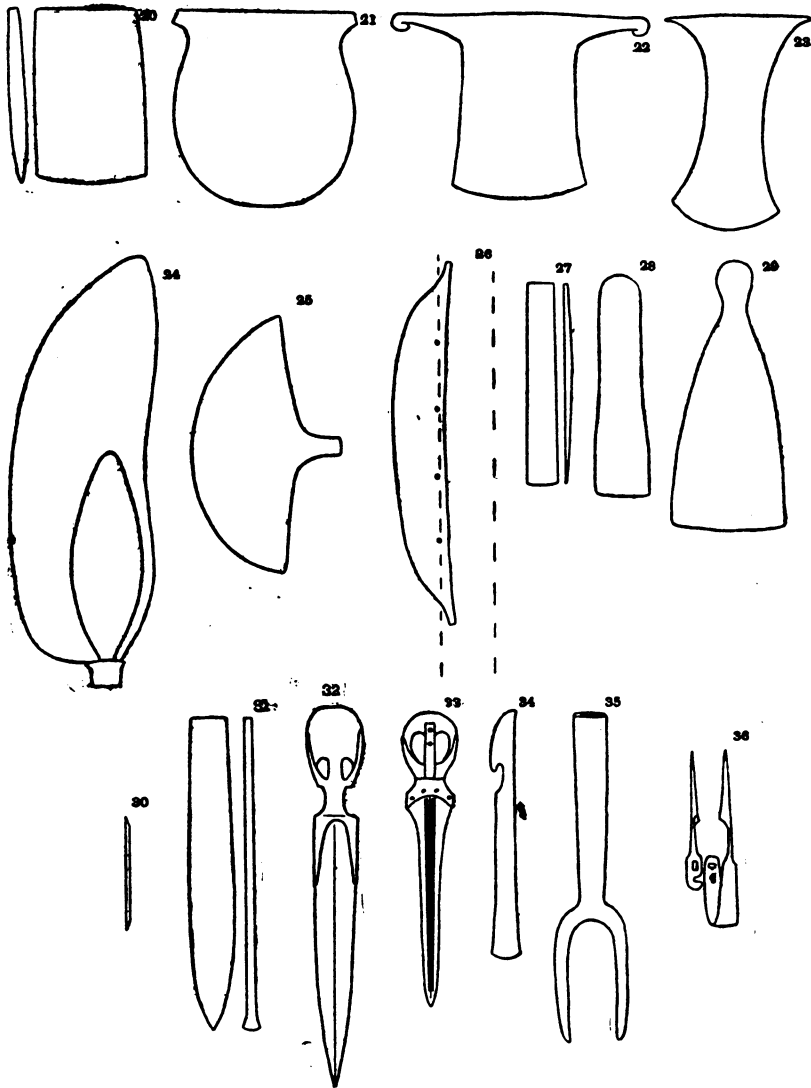
round links as far back as the second dynasty, 5,200 B.C. ; and links doubled up, and looped through each other, appear in the sixth dynasty, 4,200 B.C. Yet chains were not commonly used till much later. The Gauls excelled in such work, as they used chain cables and rigging in place of rope, to resist the Atlantic gales. The screw was a Greek invention, and greatly used by the Romans as a means of motion. Then centuries passed before the nut and screw, for fastening, was invented ; and again centuries before the screw used to fasten wood, which first appears less than two hundred years ago.

The light that the distribution of tools throws on the status of ancient civilisation is most valuable historically. Not only does the using of certain tools show a level of work and ability, but the resistance to the adoption of forms known elsewhere shows that there was a sufficient ability already in a country. In the present day the forms of common tools differ in various parts of Europe, because each country has a civilisation strong enough to carry on without copying another country. A large improvement in one country is the only condition on which other countries will borrow from it, and only then if the changes will suit other conditions. When we find that countries, known to have been anciently in connection, each steadily resisted various forms of tools used by the other, we have good evidence that each civilisation was on such a level that it could supply all its wants without great benefit by imitating another. This form of evidence gives some insight into dark ages, of which but little detailed knowledge is preserved ; it suffices to show whether countries were far below one another, or on such an equality of work that each was independent.

In Egypt there were many forms of tools and weapons, which were then the standard types, and yet these are never found in other lands. The earliest axe (fig. 20) is a plain square form, from about 6,000–5,000 B.C. Then a round axe (fig. 21) was adopted till nearly 3,000 B.C. After that wider lugs were developed to enable it to be firmly bound on to a handle (fig. 22) ; and this was made in a lighter and longer form as a battle-axe (fig. 23) used mainly about 1,500 B.C. None of these forms are found in other countries, yet had the lands around Egypt been much behind in their axe forms, they would naturally have been influenced by Egyptian types, as there was trade intercourse during all these periods. The only adoption



of such forms was due to entirely independent reinvention of the axe with lugs in South America, without any intermediate



20 to 36.—Forms of tools peculiar to Egypt.

example. The form is a natural one to adopt in hammered copper, for getting a firm attachment to the handle.

Other adaptations of the axe were the large blade of curved outline on the end of a pole (fig. 24), the half-round halberd

(fig. 25), and the long edge set in a stout baton (fig. 26) for a cutting blow. All of these were common in Egypt, but never spread elsewhere.

The adze in Egypt was at first a straight long blade of copper with parallel sides (fig. 27). Later it developed a rounded head-end (fig. 28), with contracted neck (fig. 29), to aid in binding it on a handle. Neither of these was copied in any other country.

The chisel was at first sharp at both ends, and held by the middle (fig. 30). Later there is a deep mortising chisel with an equal curve of each face (fig. 31). Neither of these Egyptian forms appears anywhere else.

The dagger, from prehistoric times onward in Egypt, had a crescent handle held in the palm of the hand (fig. 32), so as to use the weight of the arm end-on for a thrust ; whereas the European dagger was always held as a knife, across the hand. The Egyptian ornament was by parallel ribs along the axis (fig. 33) ; in all other countries the ornament is by lines parallel to sloping edges. Some forms are entirely restricted to Egypt, as the cutting-out knife (fig. 34) with a curved blade for cutting linen, the forked spear-butt (fig. 35), and, in Roman times, the shears with detachable leg (fig. 36), and the sickle with replaceable teeth (fig. 8).

Here, then, are seventeen tools and weapons, mostly of general importance and use in Egypt, which were none of them required by the neighbouring lands, where there must have been some useful equivalents.

The converse is equally true ; many forms were used around Egypt which never were adopted there. In Cyprus and other lands the earliest axes are of a pillowy form (fig. 15), with bulging faces. In Europe the double axe (fig. 16) was not only a tool and a weapon, but also a sacred symbol and a standard weight. In Mesopotamia the sloping socketed axe was usual (fig. 17), in Assyria the pickaxe (fig. 18). Not one of these was made by any Egyptian, and only two such were rarely brought in by Greeks in late times.

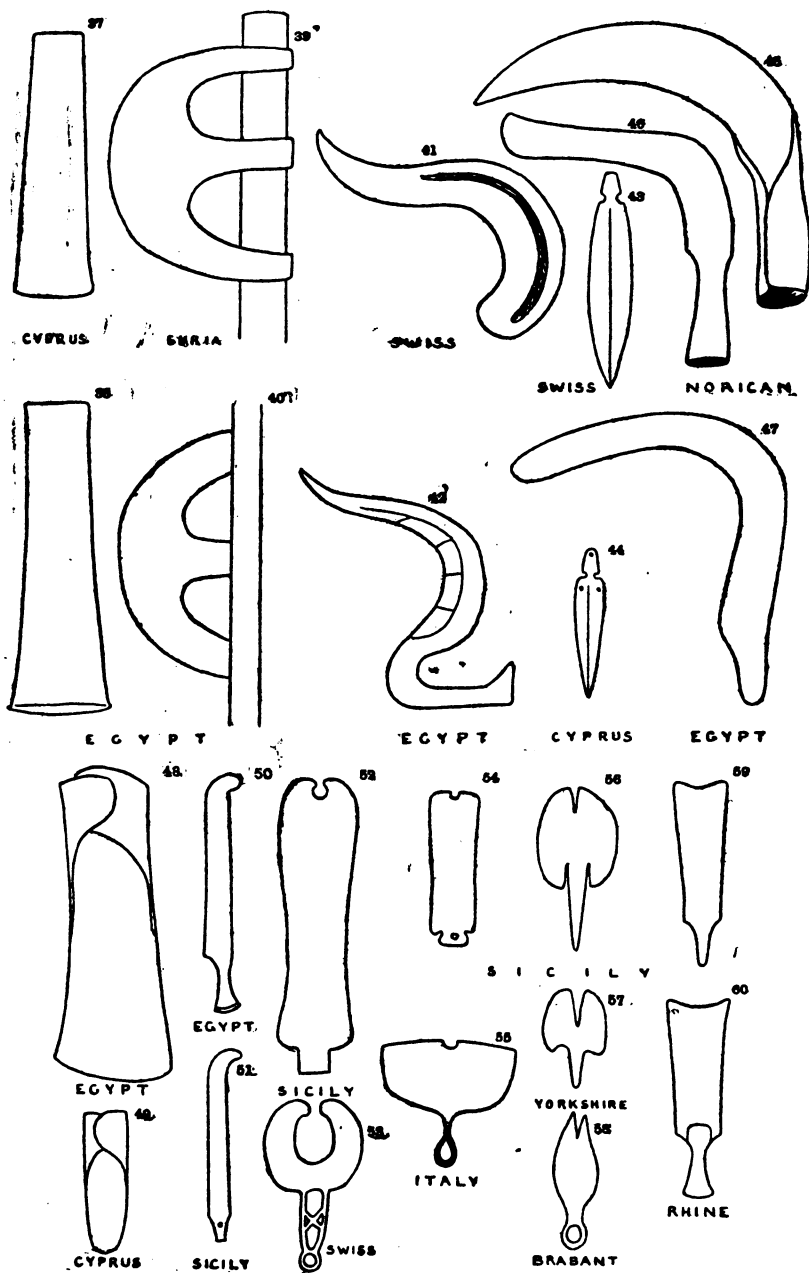
The principle of sockets for handles was well developed in Italy and spread elsewhere, for axes, hammers, and chisels, yet no Egyptian would make a socketed tool, and the only ones in Egypt were brought in by Greeks. The use of hammered sides to a blade, to form a flange for stiffening it, was of early

date in Syria, and general in the north. Yet it is rare, and probably foreign, in Egypt, and unknown in the Mediterranean. The girdle knife (fig. 19) is common in the West and in Asia; the flamboyant-blade hunting-knife (fig. 14) was usual in Italy, and spread into the north; the sword was the staple weapon in the North. Yet none of these were adopted by Egypt, and very few swords have been found there, nearly all foreign. In all these cases Egypt did not require a loan from the other lands.

This sharp separation between countries endured for thousands of years, while they were trading in food, materials, and manufacture continually. We can only conclude that each country already had, in these respects, what best suited it.

We now turn to the other historical point of view, the forms which are widely spread, because they were required. In Egypt at about 5,500 B.C. there suddenly appeared a very large wide-splayed adze (fig. 38), different from all that came before or developed later. The same large splayed adze (fig. 37) appears in Cyprus; it evidently came from there to Egypt, or both lands drew on a common source elsewhere. About 4,200 B.C. the axe with two large scollops in the back edge (fig. 40), leaving three points of attachment, suddenly appears in Egypt; a thousand years later it is far more advanced in Syria (fig. 39) than in Egypt, and it probably originated there, and spread also to Greece. About 3,000 B.C. a very strange drawing of a sickle appears in Egypt (fig. 42) unlike any other there; this is closely like a Swiss form (fig. 41). At the same time small daggers with notched tangs appear both in Switzerland (fig. 43) and in Cyprus (fig. 44). Here are links from the European copper age to the East. The same line of connection appears later, about 1,200 B.C., when the pruning-hook (figs. 45, 46) from Noricum (the modern mines of Styria) appears in Egypt (fig. 47); the rhombic arrow-head of Greece and Italy is found also in Egypt, the bronze hoe of Cyprus (fig. 49) and Egypt (fig. 48) spread northward in the Iron Age, and the European sword was rarely brought into Egypt.

An interesting confirmation of history is seen in the knives with straight parallel blades and turned-over ends. These are characteristic of the Siculi in Sicily (fig. 51), and just at the time when the Shakal people were attacking Egypt the same knife (fig. 50) is figured in an Egyptian tomb, and a specimen



37 to 51.—Forms of tools alike in East or West.

52 to 60.—Four variants of Sicilian razor, separately adopted in the North.

also has been found. This proves the connection between the Siculi and Egypt at the time.

A curious evidence of different trade routes is given by the razor. An unusual form in Sicily has a concave hollow or notch in the end (figs. 52, 54) which was reduced to a mere split (fig. 56), or a slight hollow (fig. 59). The notch form travelled into Italy (fig. 55), by the simple way across the strait. The concave hollow widened as a crescent travelled up to Switzerland (fig. 53) and Germany (fig. 60), probably by the Adriatic. The split form (fig. 56) travelled to Flanders (fig. 58) and England (fig. 57), probably by the Rhone. Here four different modifications branch from a type, and are carried by different routes to distant lands.

The triangular arrow-head is believed to have been started in South Russia. Thence it spread over Central Europe and Central Asia, and was taken by the Scythian migration into Syria about 600 B.C., and hence into Egypt.

Thus the spread of forms throughout the ancient world illustrates the movements of trade and of warfare, while the isolation of various types at the same time shows how efficient and self-supporting the ancient civilisations were in most requirements. The history of tools has yet to be studied by a far more complete collection of material, above all of specimens exactly dated from scientific excavations. It will certainly be, in the future, an important aid in tracing the growth and decay of civilisations, the natural history of man.